Introduction

THERE are many livestock facilities in the United States that handle manure as liquids and slurries. Stored manure liquids and slurries decompose anaerobically (i.e., in the absence of oxygen) producing large volumes of gas. This gas is often referred to as biogas. Biogas contains between 60-80% methane (about 600-800 BTU/ft^3) and is considered a renewable energy resource.

Substantial opportunities exist across the country to recover and use biogas energy by adapting manure management practices to include biogas generation and collection. This handbook focuses on identifying and evaluating opportunities for recovering and utilizing this energy through the implementation of biogas technology.

This handbook is for livestock producers, developers, investors, and others in the agricultural and energy industry that may consider biogas technology as a livestock manure management option. The handbook provides a step-by-step method to determine whether a particular biogas recovery system is appropriate for a livestock facility. This handbook complements the guidance and other materials provided by the AgSTAR program to the development of biogas technologies at commercial farms in the United States.

The AgSTAR Program

The AgSTAR program is a voluntary program designed to encourage the widespread use of livestock manure as an energy resource. It is a first step in recovering the value of this agricultural by-product. In this program, representatives of the livestock, energy, and government sectors have come together to promote the use of cost effective biogas recovery systems that reduce pollution while producing financial and operational benefits.

The AgSTAR program estimates that over 2,000 livestock facilities across the U.S. could install cost effective biogas recovery systems. The program is committed to assisting such facilities to realize the benefits the technology offers and to overcome the barriers limiting the adoption of biogas recovery technologies. These barriers include:

- Poor technical and economic perception; and
- Lack of technical information and expertise.

This handbook is a key component of the AgSTAR program's commitment. It contains key information required to make an informed business decision regarding the installation of a biogas recovery system.

Introduction

Organization of this Handbook

This handbook is organized into chapters according to the process of biogas project development as presented in Exhibit 1. Chapter 1 provides an overview of the technology. The subsequent chapters lead you through two stages of project development. Supporting information is included in the appendices. The two stages of project development are:

I. **Project Feasibility Assessment.** Chapters 2, 3 and 4 provide guidance on screening for project opportunities, selecting a gas use option and conducting site-assessments to identify technically appropriate and cost-effective biogas recovery option(s).

II. **Project Implementation.** Chapters 5 through 8 discuss the steps to develop a biogas project. The steps include: securing an energy contract; selecting a developer; obtaining project financing; and complying with permitting requirements.

Exhibit 1 Project Development Process

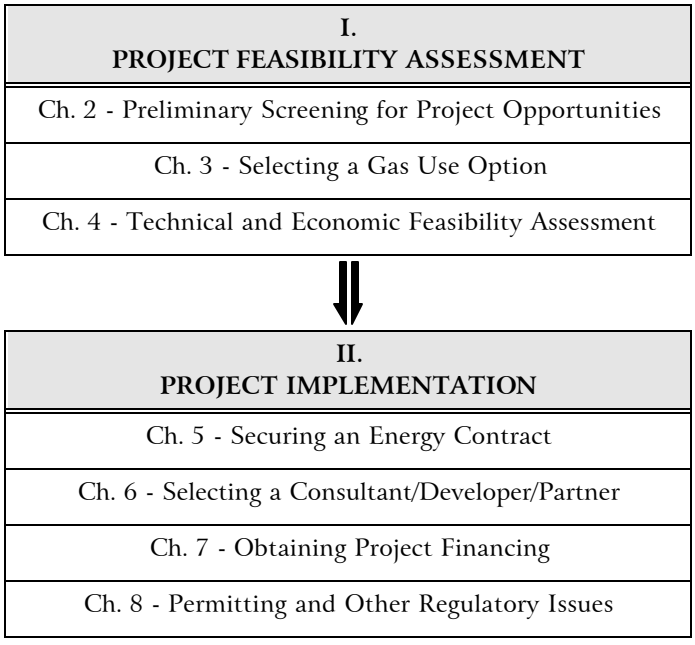

Exhibit 2 summarizes how this handbook can be used to meet various objectives. The first column lists several common objectives and the second column lists the chapter to consult and key elements of that chapter.

Introduction

Exhibit 2 How to use this Handbook - Quick Reference

OBJECTIVE	CHAPTER TO CONSULT
I WANT AN OVERVIEW OF BIOGAS TECHNOLOGY? - **W**hat is biogas technology? - **W**hy would I use biogas technology? • **H**ow successful has biogas technology been?	**1. Overview of Biogas Technology** 1.1 What is Biogas Technology? 1.2 Benefits of Biogas Technology 1.3 The U.S. Biogas Experience
Part I. Project Feasibility Assessment	
SHOULD I CONSIDER BIOGAS RECOVERY AS AN OPTION FOR MY LIVESTOCK FACILITY? - **H**ow do I know if my facility is ready to operate a biogas system? - **W**hat information do I need to identify promising opportunities for a biogas system? - **H**ow do I know if I have the skills and support to operate a biogas system?	**2. Preliminary Screening for Project Opportunities** 2.1 Is Your Facility "Large", with Animals in Confinement? 2.2 Is Your Manure Management Compatible with Biogas Technology? 2.3 Is there a Use for Energy? 2.4 Can You Manage the Farm Effectively? 2.5 Initial Appraisal Results
CAN I USE BIOGAS AT MY FACILITY ? - **W**hat are the main uses of biogas? - **H**ow do I determine which biogas utilization option will maximize economic return? - **W**hat are the electricity generation options? How do I determine which option is suitable for my facility?	**3. Selecting a Gas Use Option** 3.1 Electricity Generation 3.2 Direct Combustion 3.3 Other Options
IS A BIOGAS SYSTEM TECHNICALLY AND FINANCIALLY FEASIBLE FOR MY FACILITY ? - **H**ow do I decide which biogas technology is appropriate for my livestock facility? • **W**hat information do I need to evaluate the technical and economic feasibility of a biogas project? • **H**ow do I compare the costs and revenues from a biogas project?	**4. Technical and Economic Feasibility Assessment** 4.1 Match a Digester to Your Facility's Waste Management Practices 4.2 Complete Evaluation Sheets 4.3 Enter Information into FarmWare/RateVision 4.4 Evaluate Results
Part II. Project Implementation	

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OBJECTIVE	CHAPTER TO CONSULT
How Do I Close The Utility Deal? • **D**o I need a utility deal? • **H**ow do I know if I'm getting the best possible deal? • **H**ow do I negotiate a "win/win" deal? • **W**here do I get help?	**5. Securing an Energy Contract** 5.1 Operation Modes 5.2 Intertie Requirements 5.3 Who to Contact 5.4 What to Ask for 5.5 Elements of and Agreement 5.6 Why Negotiate and What to Watch Out For 5.7 Future Possibilities for Selling Electricity
How Do I Select A Consultant/Developer/Partner? • **H**ow do I know whether I need a consultant/developer/partner? • **W**hat should I look for in a consultant/developer/partner? • **W**hat should I include in a contract?	**6. Selecting a Consultant/Developer/Partner** 6.1 The Do-it-Yourself/Turnkey Decision 6.2 Selecting a Consultant/Consulting Firm 6.3 Selecting a Turn-Key Developer 6.4 Selecting a Partner 6.5 Preparing a Contract
How Do I Get Financing For The Project? • **W**hat are the sources of funding for biogas projects? • **W**hat do lenders/investors look for? • **H**ow do I evaluate different financing options?	**7. Obtaining Project Financing** 7.1 Financing: What Lenders/Investors Look For 7.2 Financing Approaches 7.3 Capital Cost of Different Financing Alternatives
What Do I Need To Know About The Permitting Process? • **W**hat permits do I need? • **H**ow do I get these permits? • **D**o I need to worry about meeting air quality emission standards from IC engines?	**8. Permitting and Other Regulatory Issues** 8.1 The Permitting Process 8.2 Zoning and Permitting 8.3 Community Acceptance 8.4 Regulations Governing Air Emissions from Energy Recovery Systems
Where Can I See Profiles of Biogas Systems That Are Currently Operational?	**Appendix A:** Profiles of U.S. Commercial Farm Digesters
Where Can I Get a List of NRCS and Other Key Contacts?	**Appendix B:** List of NRCS and U.S. Department of Energy Regional Contacts.
Where Can I Get Help on Using FarmWare?	**Appendix C:** FarmWare User's Manual - Version 2.0
Where Can I Get Help on Using RateVision?	**Appendix D:** RateVision User's Manual - Version 1.0
Are There Sample Case Studies Which Demonstrate FarmWare and RateVision?	**Appendix E:** FarmWare Case Studies

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WHERE CAN I GET THE NRCS PRACTICE STANDARDS?	**Appendix F:** NRCS Interim Practice Standards
WHAT INFORMATION IS NEEDED FROM THE UTILITY FOR A PRELIMINARY FEASIBILITY ASSESSMENT?	**Appendix G:** Utility Letter of Request (Sample)
WHERE CAN I SEE WHAT TYPICAL UTILITY RATE SCHEDULES LOOK LIKE?	**Appendix H:** Utility Rate Schedules, Riders, and Intertie Requirements (Samples)
WHERE CAN I GET A LIST OF DEVELOPERS AND EQUIPMENT SUPPLIERS?	**Appendix I:** List of Designers, Equipment Suppliers, and Vendors
WHERE CAN I GET DEFINITIONS OF TECHNICAL TERMS MENTIONED IN THIS HANDBOOK?	**Glossary**